 National Transportation Safety Board FACTUAL REPORT AVIATION		NTSB ID: NYC04FA117		Aircraft Registration Number: N4NY	
		Occurrence Date: 05/04/2004		Most Critical Injury: Serious	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place Brooklyn	State NY	Zip Code 11226	Local Time 1820	Time Zone EDT	
Airport Proximity: Off Airport/Airstrip		Distance From Landing Facility:			
Aircraft Information Summary					
Aircraft Manufacturer Eurocopter		Model/Series AS-350BA		Type of Aircraft Helicopter	
Revenue Sightseeing Flight: No			Air Medical Transport Flight: No		
Narrative					
<p>Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:</p> <p>HISTORY OF FLIGHT</p> <p>On May 4, 2004, about 1820 eastern daylight time, a Eurocopter AS-350BA, N4NY, operated by Helinet Aviation Services as WNBC News Chopper 4, was destroyed after it experienced a loss of control while hovering, and impacted residences in Brooklyn, New York. The certificated commercial pilot and a passenger sustained serious injuries, while one passenger sustained minor injuries. Visual meteorological conditions prevailed and no flight plan had been filed for the local flight that departed the Teterboro Airport (TEB), Teterboro, New Jersey. The electronic news gathering (ENG) flight was conducted under 14 CFR Part 91.</p> <p>The accident flight was the helicopter's second flight of the day. The pilot was seated in the front right seat, a reporter was seated in the front left seat, and a recently hired pilot was seated in the rear middle seat, for both flights.</p> <p>The first flight departed Teterboro Airport about 1400 and returned about 1600, without incident. The helicopter was then refueled, preflight inspected, and departed about 1630 for a regularly scheduled ENG flight.</p> <p>During an interview, the pilot stated he recalled hovering at 1,000 to 1,200 feet; however, he did not have any specific recollection regarding the beginning of the accident sequence. His first memory was of the helicopter in an extreme nose down position. He pulled aft on the cyclic and the helicopter began to pitch up; however, he felt that the helicopter was not responding to his control inputs, "the way it should be," and he attempted to land on a rooftop. The pilot could not provide any specific details regarding the control forces he experienced; except that he "made full inputs", and was "working the pedals back and forth, but nothing seemed to happen." He did not recall observing any warning lights, or hearing any audible warnings.</p> <p>The pilot was communicating with the John F. Kennedy International Airport (JFK) air traffic control tower at the time of the accident. The pilot did not recall reporting any specific problems over the radio; however, review of communication recordings revealed that the pilot stated he experienced a "tail rotor failure."</p> <p>The reporter stated that the helicopter was hovering over Flatbush Avenue, and East 29th street. He was preparing to file a report, when the helicopter "veered violently to the left." He also heard a warning horn and observed a red or green warning light illuminate. He recalled the helicopter being "out of control and going into a nose dive," before he blacked out. He had no further memory of the accident.</p> <p>The pilot seated in the rear seat stated that the helicopter was hovering at an altitude of about 1,300 feet, and facing between 270 and 290 degrees, when it pitched down and yawed to the left. He</p>					
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was not able to look at the instrument panel and was not aware if any warning lights illuminated; however, he did hear an intermittent horn. The helicopter was unstable as it pitched up, down and entered a dive.

The helicopter descended and struck the roof parapet of a 4-story building, before it impacted and came to rest on the roof of an adjacent 2-story building, on Cortelyou Road, between East 25th and 26th streets.

A portion of the accident flight, including the impact, was recorded by a WABC News Channel 7 helicopter. In addition, a portion of the accident flight preceding the impact was recorded from the accident helicopter. All images of the accident were forwarded to the Safety Board's Vehicle Recorder Division for further review.

The accident occurred during the hours of daylight, and was located approximately 40 degrees, 38.643 minutes north latitude, and 73 degrees, 57.187 minutes west longitude.

PERSONNEL INFORMATION

The pilot held a commercial pilot certificate for rotorcraft, with an instrument rating. He attended a Eurocopter factory training course for the AS-355, which utilized a dual hydraulic pump system, on June 25, 1982. He had not attended a factory training course for the AS-350. He was hired by Helinet Aviation Services during December 1996. He had not flown at all during April through September 2003. He began flying part-time in October, and had been flying about 5 days a week since January 2004. The pilot's most recent flight review was conducted on January 13, 2004. The pilot stated that his logbook was not current. He estimated that he had accumulated about 6,500 hours of total flight experience, which included about 350 hours in the same make and model as the accident helicopter. Helinet reported that the pilot had flown about 20 hours during the 30 days that preceded the accident.

The pilot's most recent Federal Aviation Administration (FAA) second class medical certificate was issued on May 16, 2003.

The pilot seated in the rear seat held a commercial pilot certificate for rotorcraft, with an instrument rating and a certified flight instructor certificate. He was hired by Helinet Aviation Services on April 19, 2004, and completed a Eurocopter factory AS-350 training course on April 30, 2004.

He reported 3,000 hours of total flight experience on his most recent application for an FAA second class medical certificate, which was issued on April 8, 2004.


AIRCRAFT INFORMATION

The helicopter was manufactured in 1988 and purchased by the owner, Horsham Valley Airways, Inc., on July 3, 2002. The helicopter was leased to Helinet Aviation Services beginning on March 8, 2004. At the time of the accident, the helicopter had been operated for about 8,426 total hours. The helicopter had been operated for about 48 hours since its most recent 100 hour inspection, which was performed on April 19, 2004.

The helicopter was equipped with a Turbomeca Arriel 1 engine, which was overhauled on October 23, 2003. At the time of the accident, the engine had accumulated about 6,740 total hours since new, and 441 hours since the overhaul.

Hydraulic System description

According to the AS-350BA flight manual, to reduce pilot workload, the flight controls were

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hydraulically boosted in order to give very light control load on the cyclic stick, collective lever, and tail rotor pedals. There were three main rotor servos, one longitudinal and two lateral; and also a tail rotor servo for yaw control. A single gear-type hydraulic pump generated hydraulic power. The hydraulic pump was mounted on the rear of the transmission housing, and was driven at a constant speed, with a constant discharge flow of 6 liters per minute, by a flat synthetic drive belt. The belt was driven by a pulley located immediately forward of the main drive shaft. The three main rotor servos each contained a nitrogen pre-charged accumulator that was designed to provide the pilot with continued hydraulic assistance for a limited time in the event of a hydraulic pressure loss. The tail rotor servo was not equipped with an accumulator.

A toggle switch located on the collective pitch lever allowed the hydraulic system to be selected on and off. Selecting the switch to "off" position opened three-solenoid valves, one on each of the main servo actuators, and caused any residual or hydraulic backpressure at the actuator to be dissipated. This would reduce the forces required to move the servo actuators providing a manual reversion capability to allow the pilot to retain control of the helicopter in the event of a servo jam or a loss of hydraulic system pressure. The hydraulic system low-pressure switch would activate when the hydraulic system pressure dropped below approximately 35 bars, or 515 PSI. This would then illuminate a red "HYD" warning light on the Warning Caution Advisory Panel (WCAP) and produce a continuous tone from a warning horn. The same horn provided warning of low main rotor RPM. The horn would remain on until the failure condition was removed or the pilot canceled the horn. The horn may be cancelled by pressing the horn cancel button on the Systems Control Console. The amber "HORN" light on the WCAP would illuminate as a reminder that the horn had been cancelled.

METEOROLOGICAL INFORMATION

A weather observation taken at JFK, located about 9 miles east of the accident site, at 1829, reported: winds from 310 degrees at 14 knots, with 20 knot gusts; visibility 10 statute miles; few clouds at 6,500 feet, a broken cloud layer at 25,000; temperature 59 degrees F, dew point 27 degrees F; altimeter 29.96.

COMMUNICATIONS

The Safety Board reviewed the helicopter's last radio transmissions, which were recorded by the JFK air traffic control tower. A distress transmission was received from the accident helicopter; which stated, "Chopper 4 tail rotor failure I'm going for the Sears and Roebuck." The microphone in the helicopter appeared to be keyed for some time after the distress call. Another aircraft then made a normal radio call. A second transmission from the accident helicopter began ten seconds after the first, which stated, "Chopper 4 I'm going down." Approximately three seconds later, a sound similar to a warning horn was heard for one second, followed by a break, followed by another second of warning horn. There were no further known transmissions from the accident helicopter.

WRECKAGE INFORMATION

The main cabin of the helicopter came to rest upright on a magnetic heading of 150 degrees. The main canopy was compromised. The forward half of the left skid was separated, and the aft half was buckled inboard about 60 degrees. The right skid remained attached and was not noticeably compressed. The helicopter's tail boom separated during the impact sequence and was found upright, on a heading of 290 degrees, on the west side of the helicopter. One tail rotor blade was located on the roof where the initial impact occurred and the other was located on the ground, between the two buildings. The transmission was torn from its respective mounts and located between the tail boom and main cabin area.

All major portions of the helicopter were accounted for at the accident scene. Flight control continuity of the cyclic and collective controls was confirmed from the controls in the cockpit,

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through the mixing unit. Continuity beyond the mixing unit through the swash plate could not be verified due to damage associated with the separation of the transmission. Tail rotor control continuity could not be confirmed due to the separation of the tail boom. It was noted that the tail rotor connections were intact from the pedals to the flexible control cable in the main cabin.

The tail rotor pitch controls remained intact from the pitch change servo, through the pitch change bellcrank, and to the slider assembly. Both pitch change rods remained attached at the slider assembly; however, one rod was bent and remained attached to the pitch change horn, while the other rod remained relatively straight and was fractured at the pitch change horn bearing.

The tail rotor drive shaft remained intact from the gear box to the intermediate drive shaft spline. The drive shaft splines were not damaged and the drive shaft could be manipulated to rotate the tail rotor through the gearbox. Circumferential scoring was observed on the tail rotor drive shaft cover above the point where the tail rotor drive shaft connected to the intermediate drive shaft. The intermediate drive shaft coupling contained rotational scoring and was located on the roof where the helicopter came to rest. The tail rotor gear box magnetic chip detector was absent of debris. The tail rotor pitch servo was removed. The servo was actuated through it's full range of motion and pumped an undetermined amount of hydraulic fluid.

The engine remained attached to the airframe. All engine fuel and oil lines were intact and connected. The compressor was seized and gouges were observed on the compressor blades. In addition, circumferential scoring was observed on the compressor cone. The containment shield which surrounded the free turbine, was elongated at the 9-o'clock position and contained outward denting. A hole was observed in the module 5 engine compartment and the free turbine was fragmented. All magnetic chip detectors were normal, except for the module 5 chip detector, which was covered with metallic debris. Engine modules 2 and 3 were separated from module 1 and the accessory drive shaft was broken.

The engine fuel filter was absent of contamination. According to the New York City Fire Department, about 80 gallons of fuel was drained from the helicopter's fuel system.

The upper and lower transmission metallic chip detectors were absent of debris. The main transmission input displayed rotational scoring. The hydraulic pump drive belt was separated and located near the transmission. The hydraulic pump was removed and rotated freely. The hydraulic pump drive coupling remained intact. The hydraulic system toggle switch was found in the "on" position.


Several components from the helicopter were retained for further examination. They included: Both tail rotor pitch change horns, both pitch change control rods, the hydraulic pump, hydraulic pump belt, tail rotor drive cable, and the WCAP were forwarded to the Safety Board's Material's Laboratory. The hydraulic control servos, hydraulic distribution manifold, and the engine were also retained.


TESTS AND RESEARCH

A teardown of the engine, and a functional check of the fuel control unit conducted at Turbomeca, Grand Prairie, Texas, under the supervision of the NTSB investigator-in-charge did not reveal any pre-impact malfunctions. Damage consistent with a power turbine overspeed was noted. According to the engine manufacturer, the overspeed occurred when the flexible coupling of the engine to helicopter transmission shaft fractured during the accident sequence.

The following components were examined by, or under the supervision of a Safety Board investigator. (The respective factual report for each component can be found in the public docket).

Tail Rotor Drive Cable

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<p>The tail rotor drive cable was a push/pull type cable that transmitted the tail rotor pedal movement to the tail rotor hydraulic servo actuator, which in turn operated the pitch change mechanism of the tail rotor. Examination of the separated tail rotor drive cable by a Safety Board Metallurgist did not reveal any evidence of a pre-impact failure.</p> <p>Warning Caution Advisory Panel (WCAP)</p> <p>Examination of the WCAP revealed that each indicator contained two light bulbs. The light bulbs were removed and examined visually for any evidence of damage. The majority of the light bulb filaments appeared to be in a normal condition, and displayed no evidence of stretched coils. The only exceptions were that both "PITOT" bulbs were fractured, one of the "HYD" and "HORN" bulbs were fractured. The fractured filaments were consistent with damage caused while the filaments were impacted at low operating temperature.</p> <p>Tail Rotor Pitch Assembly Links</p> <p>The fractured link fracture surface was shiny and rough with features consistent with overstress, with no evidence of pre-impact failure. The link appeared straight, except for the localized deformation adjacent to the fracture surface. The opposite link had a general bend, but was not fractured.</p> <p>Hydraulic System Components</p> <p>Drive Belt</p> <p>The hydraulic pump drive belt was a flat type identified with the part number "704A33690004". The belt was measured at 0.623-inch wide, 0.030-inch thick and 22-inches long. According to the applicable drawing provided by Eurocopter, the belt was manufactured from "FILON TYPE FO" and had two distinctive surfaces. A tissue surface on which the direction of rotation arrow was printed and an elastomeric surface. The drawing also indicated that the belt should be installed with the direction of rotation arrow on the outer surface. Based on the curvature of the drive belt, it had been installed on its pulleys with the tissue surface, displaying the direction arrow and part number, facing the inner surface. The drive belt had separated approximately 0.7-inch forward of the tip of the direction of rotation arrow, and the part number located on the inner surface of the belt. In addition, the separation was located at a manufacturing seam where the two ends of the belt were bonded together.</p> <p>Hydraulic Pump and Pulley Assembly</p> <p>The hydraulic pump pulley rotated easily on it's bearing, and internal examination of the hydraulic pump assembly did not reveal any pre-impact failures. It was noted that the coupling sleeve plug, which helps retain lubricating grease for pulley assembly was not installed.</p> <p>Hydraulic Servo Actuators</p> <p>Examination of the main, and tail rotor hydraulic servo actuators did not reveal any pre-impact failures.</p> <p>ADDITIONAL INFORMATION</p> <p>Video Study</p> <p>The accident helicopter was equipped with an on-board video recording system, intended to provide video coverage for WNBC News Channel 4. The accident sequence was also captured on video from a WABC News Channel 7 helicopter, which was hovering in the vicinity. The NTSB Vehicle Recorder</p>		
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Division received a total of six recordings, including five videotapes and one audiotape, associated with the accident.

The video camera onboard the WNBC News Channel 4 helicopter captured the moments before and during the initial upset. The helicopter was hovering and the camera was seen scanning the area. Then abruptly, the helicopter started shaking and oscillating violently. The view appeared to shift right at the beginning of the shaking. A sound similar to a warning horn was heard immediately after the shaking began. The reporter's voice was also heard. Static interference begins a couple of seconds later. Video and audio come back for two brief periods before complete static occurred until the end of the recording.

The WABC News Channel 7 helicopter captured the accident sequence from its onboard camera. Initially, the Channel 4 helicopter was barely visible on the screen. The camera zoomed in on the helicopter, which was observed entering a steep descent and quickly leveling off. A fairly constant, level attitude and heading was briefly maintained before the helicopter came to an unstable hover and began an approximate two revolution left rotation about its vertical axis. During the rotation, the helicopter was descending and then impacted a building. The helicopter came to rest upright on top of an adjacent building.

A video study was conducted to estimate the main rotor blade speed in revolutions per minute (RPM) to determine if the warning horn, detected in the recordings, was due to low main rotor blade speed. A digitized portion of the WABC News Channel 7 video recording of the accident sequence was analyzed in an effort to estimate the helicopter's main rotor blade speed prior to impact. The segment analyzed was approximately seven seconds long and contained a relatively straight and level segment of flight beginning 10 seconds after the initial upset was captured. The main rotor blade speed was calculated by analyzing each frame of the video recording and comparing rotor blade position with respect to time. One of the three blades was monitored in each frame and the time in seconds and frames was recorded when one revolution was completed. The average main rotor blade speed was calculated over three different intervals of 5 revolutions, 10 revolutions, and 15 revolutions. Through all of the trials, the highest main rotor blade speed calculated was 391.4 RPM and the lowest main rotor blade speed calculated was 375.0 RPM.

According to a representative from Eurocopter, the low rotor horn should sound if the main rotor speed dropped below 360 RPM.

[For additional information regarding all audio and video tapes examined, see the NTSB Video Study Report in the public docket.]

Hydraulic System Pre-Flight Checks

The helicopter flight manual required two hydraulic system tests prior to each flight.

The hydraulic accumulator test enabled the pilot check that the accumulators would provide hydraulic assistance should the hydraulic power system fail, and that the "HYD" warning light and the horn operate to indicate a loss of hydraulic pressure.

The hydraulic pressure cut-off test enabled the pilot to check the electro valves of the main servos for correct operation. These electro valves are used to cut off the hydraulic power system in accordance with the AS-350 Flight Manual Emergency Procedures, in the event of a hydraulic power system failure or other flight control malfunction.

During an interview, the pilot initially stated that he did not perform the required hydraulic system checks prior to flight, because he did not want to "fool around" with the hydraulic system. In a follow-up interview, the pilot said that he performed the required hydraulic system checks

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before the first flight on the date of the accident; however, during an interview, the pilot seated in the rear seat stated that he specifically recalled that the pilot did not perform the hydraulic system checks before either flight on the date of the accident.

Hydraulic Pump Drive Belt Failure and Emergency Procedure

Review of the helicopter system schematics revealed that a hydraulic pump drive belt failure during flight would result in an unexpected loss of hydraulic system pressure causing the illumination of the red "HYD" warning light on the Warning Caution Advisory Panel (WCAP), and produce a continuous tone from the warning horn. Immediately after a loss of hydraulic pressure, the nitrogen-filled accumulators on each of the main servo actuators would provide hydraulic assistance between 30 and 45 seconds, depending on control inputs, allowing the pilot to adjust the speed of the helicopter and land the helicopter by controlling the main and tail rotor servos in manual mode. According to Eurocopter, a rapid, short yaw would be the first indication of a hydraulic failure, followed many seconds later by stiff cyclic and collective flight controls.

According to Eurocopter's emergency procedures for the helicopter, the pilot action following a hydraulic system failure was to "calmly reduce collective pitch and adjust the airspeed to between 40 and 60 knots in level flight" and then cut off the hydraulic pressure, by moving the toggle switch located on the collective pitch lever to off.

When the accumulators are exhausted, the control forces become significantly higher, and according to Eurocopter, "not unmanageable." The helicopter could be controlled without the main and tail rotor servo actuators hydraulically powered, but this would require the pilot to apply "non-negligible" forces that are substantially different than the forces required with the hydraulic system operating properly. The main rotor control forces vary with the helicopter's airspeed. As the airspeed increases, the control forces increase.

According to Eurocopter, the time to transition from hover flight to between 40 and 60 knots was 30 seconds. In addition, the landing after a hydraulic system failure should be performed with "a slight forward speed."


Hydraulic Pump drive belt History


According to the airframe logbook, the most recent entry which documented the replacement of the hydraulic pump belt was on December 28, 2002, about 950 hours prior to the accident. However, subsequent review of work orders revealed that the hydraulic pump drive belt was replaced on October 13, 2003, 442 hours prior to the accident. According to the mechanic who maintained the helicopter for Helinet, he had not removed and re-installed the belt during any of the maintenance he performed. The service life of the hydraulic pump belt was 600 hours.


Review of Eurocopter maintenance work card 63.00.00.401, which included the procedures for replacing the hydraulic pump belt, and belt tensioning, revealed that section 4.2.1 stated in part, "the arrow indicates the rotation direction." The work card did not include any additional guidance regarding the surface orientation of the belt when installed.


On May 11, 2004, Eurocopter released Service Bulletin AS350, No.63.00.08, to improve hydraulic pump drive operation by offering an improved "Poly-V" hydraulic pump drive belt. The Poly-V belt had a service life of 1,500 hours and contained multiple longitudinal "v" shapes on its inner surface that mated with similar grooves on the hydraulic pump pulley. The Service Bulletin recommended that operators of helicopters AS-350 type versions B, B1, B2, B3, BA, BB, D, and L1 replace the hydraulic pump drive pulley and pulley bearings, and replace the hydraulic pump "flat" drive belt with the new and improved "Poly-V" belt.

Wreckage Release

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<p>The helicopter wreckage was released on April 14, 2005, to a representative of the owners insurance company.</p>		
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		Occurrence Type: Accident			
Landing Facility/Approach Information					
Airport Name	Airport ID:	Airport Elevation Ft. MSL	Runway Used NA	Runway Length	Runway Width
Runway Surface Type: Unknown					
Runway Surface Condition: Unknown					
Approach/Arrival Flown: NONE					
VFR Approach/Landing: None					
Aircraft Information					
Aircraft Manufacturer Eurocopter		Model/Series AS-350BA		Serial Number 2121	
Airworthiness Certificate(s): Normal					
Landing Gear Type: Skid					
Amateur Built Acft? No	Number of Seats: 5	Certified Max Gross Wt. 4630 LBS		Number of Engines: 1	
Engine Type: Turbo Shaft	Engine Manufacturer: Turbomeca		Model/Series: Ariel 1B	Rated Power: 590 HP	
- Aircraft Inspection Information					
Type of Last Inspection Continuous Airworthiness	Date of Last Inspection 04/2004	Time Since Last Inspection 48 Hours		Airframe Total Time 8377 Hours	
- Emergency Locator Transmitter (ELT) Information					
ELT Installed?/Type No	ELT Operated?	ELT Aided in Locating Accident Site?			
Owner/Operator Information					
Registered Aircraft Owner Horsham Valley Airways Inc.		Street Address 450 Caredean Drive			
		City Horsham	State PA	Zip Code 19044	
Operator of Aircraft Helinet Aviation		Street Address 16425 Hart Street			
		City Van Nuys	State CA	Zip Code 91406	
Operator Does Business As:			Operator Designator Code:		
- Type of U.S. Certificate(s) Held: None					
Air Carrier Operating Certificate(s):					
Operating Certificate:			Operator Certificate:		
Regulation Flight Conducted Under: Part 91: General Aviation					
Type of Flight Operation Conducted: Other Work Use					
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Weather Information					
WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
JFK	1829	EDT	13 Ft. MSL	9 NM	105 Deg. Mag.
Sky/Lowest Cloud Condition: Few			6500 Ft. AGL	Condition of Light: Day	
Lowest Ceiling: Broken		25000 Ft. AGL	Visibility: 10 SM	Altimeter: 29.96 "Hg	
Temperature: 15 °C	Dew Point: -3 °C	Weather Conditions at Accident Site: Visual Conditions			
Wind Direction: 310	Wind Speed: 14	Wind Gusts: 20			
Visibility (RVR): Ft.	Visibility (RVV) SM				
Precip and/or Obscuration: No Obscuration; No Precipitation					

Accident Information					
Aircraft Damage: Destroyed		Aircraft Fire: None		Aircraft Explosion: None	

- Injury Summary Matrix	Fatal	Serious	Minor	None	TOTAL	
First Pilot		1			1	
Second Pilot						
Student Pilot						
Flight Instructor						
Check Pilot						
Flight Engineer						
Cabin Attendants						
Other Crew						
Passengers		1	1		2	
- TOTAL ABOARD -		2	1		3	
Other Ground						
- GRAND TOTAL -		2	1		3	

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 <p>National Transportation Safety Board</p> <p>FACTUAL REPORT</p> <p>AVIATION</p>	NTSB ID: NYC04FA117	
	Occurrence Date: 05/04/2004	
	Occurrence Type: Accident	
Administrative Information		
<p>Investigator-In-Charge (IIC)</p> <p>Luke Schiada</p>		
<p>Additional Persons Participating in This Accident/Incident Investigation:</p> <p>Anthony Mauro Farmingdale FSDO Farmingdale, NY</p> <p>Joseph A Syslo Eurocopter Grand Prairie, TX</p> <p>Archie Whitten Turbomeca USA Grand Prairie, TX</p> <p>Philippe Mauviot Bureau d'Enquetes et d'Analyses Le Bourget, France,</p>		
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